THE NATURAL HOSTPLANT OF THE GREY CARPET MOTH *LITHOSTEGE GRISEATA* D.&S. (LEP.: GEOMETRIDAE)

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I FIRST came to the Breck in 1949 and I have been closely associated with its ecological treasures ever since. During these years I have enjoyed the pleasure of seeing both wild larvae and adults of the Grey Carpet moth, from early days when the moth was a regular frequenter of old hayrick sites and stacking yards and latterly as the insect decreased in numbers to assume the role of a nomadic species that might appear casually in almost any situation both within the area of the old Breck and around it, and with the larva as a rule nowadays less frequently encountered. In all this time I have become used to the association of moth and larva with flixweed (*Descurainea sophia* (L.) Webb ex Prantl.); this plant has long been known as an opportunist of bare, light soils of which there had always been an abundance in the brecks before afforestation and intensive agriculture, whereas the oft-quoted alternative host Treacle mustard (*Erysimum cheiranthoides* L.) is largely absent from the Breck soils. I regularly monitor the Breck headlands for lepidopterous larvae and I cannot recall ever seeing *Erysimum* there. Both plants are famed as succeeding on arable land, formerly throughout the crop but flixweed today will be found only at the field edges and where the use of herbicides has been less than total, although it seems to benefit from crop cultivation, for its best performance is often in the first metre or so of headland adjacent to the crop where competition from more aggressive annuals is reduced.

Over the years I have been greatly bothered by the practice of too many authors in presenting both *Erysimum* and *Descurainea* as unqualified equally accepted wild hostplants for this moth. The earliest British record of *Descurainea* as the wild food of *griseata* is by Hellins (1867) then repeated in Buckler (1886-1910), where also the first mention of *Erysimum* as a substitute food for captive larvae is given. Since then these two plants have been quoted by British authors thus Wilson (1880), Tutt (1901-1905), Barrett (1893-1907), South (1907), Scorer (1913), Newman and Leeds (1913), Stokoe (1984). Both Barrett and Allan add a number of alternative plants said to be acceptable to captive larvae. Only Hellins (repeated in Buckler) and Tutt give accounts that read as original field observation and all the rest appear to be copied from these except for Skinner (*pers. comm.*) who himself had the larva from *Descurainea*. Hellins wrote "Mr T. Brown of Cambridge found the larva feeding on *Sysimbrium* (=*Descurainea*) *sophia*" and "the larvae, which I have had this summer, whether bred or captured, throve equally well on *Erysimum cheiranthoides*, seeds of which had been sent me in mistake for those of *S. sophia*". Tutt wrote "Towards the end of July at Tuddenham, examine the heads of *Sysimbrium* (= *Descurainea*) *sophia* which are first seeding. Many of the apparent seed pods will be found to be full-grown larvae of *Lithostege griseata*"; and again "The eggs of *L. griseata* are laid on *Sysimbrium* (=*Descurainea*) *sophia*, on which the larvae are to be found at

Tuddenham. *Erysimum cheiranthoides,* however, proves a good substitute foodplant". Most of the records of *griseata* are of adult moths but amongst the few post-war accounts of wild larvae are those by Chalmers-Hunt and Wakely (1964) thus "Larvae of *Lithostege griseata* Schf. were swept from plants of Flixweed (*Descurainea sophia*) and Tumbling Mustard (*Sisymbrium altissimum*)" and by Goater (1969) "Plenty of larvae of *Lithostege griseata* Schf., mostly full fed, were found on Flixweed *Descurainea sophia* (L.)". In "Breckland notes, with reference to the more important species" (1951) I described how *L. griseata* was associated with cultivated ground where *Descurainea* was most plentiful and that I thought *Descurainea sophia* to be the only hostplant. The more recent monumental Chart by Emmet (1991) gives *Erysimum* as the sole host, and I must plead guilty in allowing this to pass into print, as I had been invited to scrutinise all of the macro species and I overlooked this most important error.

Both *Descurainea* and *Erysimum* have been firmly classified as plants introduced by man, thus Clapham, Tutin and Warburg (1962), Trist (1979) and Petch & Swan (1968); of *Descurainea* Trist says "Established alien. Common and widespread. Mainly in arable but found in open places, road verges, tracks and on waste ground. Colonist being able to grow only in habitats created and maintained by human activities, weed of cultivation"; of *Erysimum* Trist writes "Established alien mainly in arable, less frequently on waste ground, road verges, tracks, gardens. Uncommon in the Suffolk Breckland and rarely abundant in the remaining sites in Norfolk". Despite the statements by modern botanical authors that both plants are of alien origin, there is evidence that they existed in Britain long before historical times and certainly before the first cultivation by Neolithic man who is most often credited with the introduction of ruderal species into Britain as he repopulated it from southern lands. The second edition of Godwin's *History of the British Flora* (1975) includes both *Descurainea* and *Erysimum* in the list of weeds and ruderal species recorded from fossil evidence of the late or even mid-Weichselian period, say some 10,000 to 50,000 years before present. The supposition is that when the greater part of Britain was subsequently tree-covered these and similar plants of light soils that could tolerate but little shade would have survived best in places like the Breck until clearings by man allowed them to increase.

Even more of interest is the comment by an early writer on the habitat of these two plants. John Ray (1660) says of *Descurainea* "On the borders of fields" and of *Erysimum* "In the Osier holts about the bridge at Ely, and in all the other Osier grounds by the river side there", this latter statement being something of a surprise to us today but curiously borne out by Hegi (1909-) who says unambiguously of continental *Erysimum cheiranthoides* "Scattered in gardens, in fields, on roadside and riverbanks, usually on mild humus ('mull') sandy and silty soils in summer-annual weed communities". The fact that *Erysimum* was in Ray's time a plant of damper habitat and that today it is still to be found in such places, for example, in the Norfolk Broads, as well as on heavier garden and agricultural soils suggests that it might not then have been the habitual hostplant of so light-soil demanding a species as *griseata* any more than it is today. Botanists of long-standing Breck experience

have confirmed to me that they have encountered *Erysimum* only in the odd locations where there may be boulder-clay deposits. I certainly see *Erysimum* only in my loam-over-clay-with-flints vegetable garden which is just off the Breck sands. This geometrid moth would most certainly not have survived the phases of glaciation in Britain and whether it arrived before the land link was broken or latterly, as a consequence of man's husbandry or parallel with it, is of less significance than the fact that both plants were available from these very early times.

I summarise by saying that whereas there is evidence to indicate that both *Descurainea sophia* and *Erysimum cheiranthoides* have been known from Britain since the Ice Ages and therefore both have been likely available to the larva of *griseata* from the time that the moth has also been resident, the preference of *Erysimum* for heavier soils of higher nutrient status is another factor that argues against its common availability to a moth that has never been known to be resident other than on the uniquely barren sandy calcareous soils of the Breck district of East Anglia. And whereas there are well documented instances of the larvae of *griseata* being found wild on *Descurainea* there are no records of them being found on *Erysimum* and literary references relating to this plant are of larvae fed upon it only in captivity (as with other crucifers).

When rearing *griseata* from wild females I have found eggs to be laid on all parts of the *Descurainea* plant but especially freely on the flowering shoots and young seed-pods, and that larvae fed up speedily and healthily on those parts, working their way from newly-set pods to ripened pods in the last instar. Captive stock did well when placed in cages with a gauze top in full sunshine during morning and evening, but larvae became restless in the very hot afternoon sun. I have never succeeded in rearing from the egg in plastic boxes. Although the temptation is to give dry sand for pupation, pupae are well formed in other dry media and moths may be produced over the next two summers. I cannot confirm that pupae were formed deep in their medium as noted by Newman and Leeds (1913) but I have repeatedly noted that pupae are formed without cocoons. Larvae certainly do eat seedpods of *Erysimum* in captivity and in 1997 I put a number of wild-taken larvae of about one-third to one-half grown on to *Erysimum* and watched them eat the pods and reach last instar on them, but they pupated very undersized to produce miserably small pupae.

I must record that following introduction of the conservation policy of leaving headlands in the Breck uncropped but still cultivated, there has been an abundance of *Descurainea* that have grown dense and vigorous for the first two years, then weaker on the more fertile soils until three or four years later the plant there has been largely absent, although hopefully with renewed seed-bank. Where headlands have been subsequently cultivated annually on the poorest soils *Descurainea* is a prominent constituent of the residual Breck flora, whilst cultivation in alternative years yields only sparse plants in the second year. It was the considerable ground disturbance with abundant *Descurainea* that resulted in the sudden population rise of *griseata* at the site of the leisure centre development on 1991 in Suffolk.

1997 was an outstanding season for *griseata*. It began in early June when more moths were seen in Norfolk, and more on any one night, than has been the case for

some years. A month later the first larvae were located on conservation headlands of arable land, and a survey of a series of very extensive headlands revealed an astonishing abundance of *Descurainea* distributed linearly along headlands of the standard six metres width with *Descurainea* concentrated in the first two metres, and commonly only in the first, from the edge of the crop whether corn or sugar-beet. I made larval counts on these headlands from 10 to 26 July and I found larvae of *griseata* thinly distributed throughout the series, but with higher concentrations at some locations where numbers could reach 60 (all instars) over 400 linear metres (or say 500 square metres of *Descurainea*). Only larvae up to second instar were found on younger, very green, plants with immature pods, the bulk coming from older plants with some pods showing brown, and there were some larvae – and not all fully grown – from plants quite pale brown with opened dry pods. Larvae of *griseata* were present on flixweed in close association with goosefoot, mugwort and creeping-thistle in addition to their presence in patches of pure flixweed.

The Breck headlands were resplendent in 1997 giving the finest floral display for years in white, blue and yellow, with *Silene, Echium, Descurainea, Galium* and chamomile the principal contributors. Erratic the season's weather may have been yet the alternating deluge and heat of June produced astonishing growth on these sterile soils; *Descurainea* which in most years can be expected to reach knee-height was commonly waist-high and even above this, individual plants forming grotesquely spread bushes in contrast to the normal slight, upright habit, on some sites it grew into sprawling thickets. Seed from all these plants was prodigious which augurs well for the future, but the key to the future success of both plant and moth will much depend upon retention of the environmental headlands concept. In this year of lush Breck growth and regeneration I kept an especially sharp look-out for *Erysimum* but I saw none.

The frequency of these larvae gave opportunity to witness their range of variation. In mid-growth the basic colours were beige, green or pale yellow, while last instar colours were commonly green with white lateral band, others light-brown to ochreous; examples within each instar merged one colour into the next. A few had well-patterned dorsal markings very similar to those of larvae of *Scotopteryx* species (and one wonders why current systems of classification place Lithostege so far from them). The variegated form that has black and white patches laterally with black extending dorsally is present in the penultimate and last instars but loses its clarity before full growth.

Larvae of other species found with *L. griseata* on pure *Descurainea* were: *Pieris rapae, Xestia c-nigrum, Dicestra trifolii, Autogramma gamma, Heliothis viriplaca, Mamestra brassicae, Xanthorhoe fluctata* which could look very like *griseata, Epirrhoe alternata* and *Eupithecia centaureata* whose plain green and pale yellow forms could also appear like *griseata*. The larvae of *M. brassicae* were all in their early instars when they were a delicate blue-green with paler lateral line and paler intersegmental folds, and not at all like the familiar last instar; they were heavily parasitised by the hymenopteron *Aleiodes* but by a distinctly different species from that which attacked *griseata* and *alternata*.

These *Aleiodes* that attacked *M. brassicae* were in captivity themselves subject to being eaten by large larvae of *brassicae,* a retribution hitherto unknown to me but which Shaw described in 1976 (Shaw, 1976). As Mark Shaw found, the parasitoid was consumed only when newly spun and before its case had hardened. The *Aleiodes* that attacked *griseata* were mostly hyperparasitised by *Mesochorus* (all parasitoids determined by Mark Shaw).

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